ORIGINAL PAPER

HOLSTEIN CATTLE REPRODUCTION IN RELATION ON MILK YIELD AND BODY CONDITION SCORE

REPRODUKCE HOLŠTÝNSKÉHO SKOTU V ZÁVISLOSTI NA DOJIVOSTI A KONDICI

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ABSTRACT

One of the basic conditions of the economical success in milk production is the high and periodic reproduction of the cows. That means the parturition of a healthy calf from every cow per a year. The development and level of reproduction functions is very susceptible to the quantity and mainly quality of nutrition. The insufficiency in nutrition is strongly related to the fertility. The aim of this study was to evaluate the reproduction indicators depending upon the level of the milk yield and body condition of the Holstein cows at the family-owned farm. The basic dataset was obtained during the years 2004 – 2007. The milk yield and fertility data were gained from the herd records. The extreme values were removed from the basic set. Body condition score was evaluated every month. The groups according to the milk yield level and body condition score were evaluated. The basic statistical characteristics were determined in the groups of cows and in the evaluated sets. The effect of particular factors was proved by the one-factorial analysis of variance ANOVA. Increasing milk yield in the groups with milk yield up to 7000 kg of milk, 7000-8000 kg and more than 8000 kg had negative impact on the reproduction indicators. The differences in the length of calving to first service interval among particular groups were statistically significant ($P \geq 0.01$). The average length of this interval was 96, 111 and 122 days for 1st, 2nd and 3rd group, respectively. In addition, the average length of calving to conception (service period) interval was 154, 165 and 171 days. There were found no significant differences in numbers of services per conception. The average BCS at calving was 3.59 points. After calving BCS level decreased till the 6th month of lactation, where its level 2.43 points, then the BCS level increased. Average BCS level at conception was under 2.5 points. The variation of BCS during the lactation was 2 points.

Key words: Holstein cattle; reproduction; milk yield; body condition score

ABSTRAKT

Jedním ze základních předpokladů dosahování příznivých a ekonomických výsledků produkce mléka je dobrá a pravidelná plodnost krav. To představuje narození jednoho zdravého telete od každé krávy za rok. Průběh a úroveň reprodukčních funkcí velmi citlivě reaguje na kvantitu a hlavně kvalitu výživy. Karence ve výživě se odrazí v omezení reprodukčních funkcí. Cílem práce bylo zhodnotit ukazatele reprodukce v chovu holštýnských krav v podmínkách soukromě hospodařící farmy rodinného typu v závislosti na úrovni mléčné užitkovosti a tělesné kondici krav. Shromažďování vstupních dat proběhlo v letech 2004 – 2007. Údaje o užitkovosti a plodnosti byly získávány ze zootechnické evidence, měsíčních sestav kontroly užitkovosti, laktačních listů a inseminačních karet plemenic. Získaná data byla očištěna o extrémní hodnoty. Telesná kondice byla hodnocena každý měsíc. Byly hodnoceny skupiny vytvořené podle produkce mléka a posouzena tělesná kondice v průběhu laktace. U skupin dojnic a hodnocených souborů byly zjištěny základní statistické charakteristiky. Vlivy jednotlivých faktorů byly testovány jednofaktorovou analýzou rozptylu ANOVA. Rostoucí mléčná produkce u skupin s užitkovostí do 7 000 kg, 7 000 – 8 000 kg a nad 8 000 kg mléka negativně působila na reprodukční ukazatele. Průkazné rozdíly ($P \geq 0.01$) byly zjištěny u inseminačního intervalu. Průměrná délka intervalu u skupin byla 96, 111 a 122 dnů. Délku inseminačního intervalu odrážela i průměrná délka servis periody, která byla u skupin 154, 165 a 171 dnů. Hodnoty inseminačního indexu nevykazovaly u skupin významné rozdíly. Průměrná hodnota BCS na počátku laktace činila 3,59 bodu. Po otelení úroveň kondice klesala až do šestého měsíce laktacena hodnotu 2,43 a následně se začala kondice zlepšovat. Úroveň BCS při zabřeznutí byla méně než 2,5 bodu. Hodnoty BCSv různých fázích laktace se pohybovaly v rozmezí 2 bodů.

Klíčová slova: holštýnský skot, reprodukce, mléčná užitkovost, tělesná kondice

DETAILNÍ ABSTRAKT

Cílem práce bylo zhodnotit ukazatele reprodukce v chovu holštýnských krav v podmínkách soukromě hospodařící farmy rodinného typu v závislosti na úrovni mléčné užitkovosti a tělesné kondici krav.

Shromažďování vstupních dat proběhlo v letech 2004 – 2007. Údaje o užitkovosti a plodnosti byly získávány ze zootechnické evidence, měsíčních sestav kontroly užitkovosti, laktačních listů a inseminačních karet plemenic. Získaná data byla očištěna o extrémní hodnoty. Tělesná kondice byla hodnocena každý měsíc.

Reprodukční ukazatele byly hodnoceny u skupin dojnic vytvořených podle množství nadojeného mléka za laktaci. Mezi základní ukazatele, které byly sledovány, patří: inseminační interval, servis perioda a inseminační index.

V tabulce č. 2 jsou uvedeny hodnoty inseminačního intervalu, včetně základních statistik. Mezi skupinami byly zjištěny statisticky průkazné rozdíly. Trend mezi skupinami je podobný jako u délky servis periody. S rostoucí užitkovostí roste i délka inseminačního intervalu. V každé skupině je délka servis periody cca o 55 dní větší, než je dosahovaný inseminační interval. Nejmenší průměrná hodnota inseminačního intervalu byla dosažena u skupiny s produkcí do 7 000 kg mléka – 96 dní a nejvyšší průměrná hodnota je ve skupině s produkcí nad 8 000 kg mléka – 122 dní.

V tabulce č. 3 jsou uvedeny hodnoty servis periody a základní statistiky. Mezi skupinami nebyly prokázány statisticky významné rozdíly.

V tabulce č. 4 jsou uvedeny hodnoty inseminačního indexu ve skupinách vytvořených podle produkce mléka. Mezi skupinami nebyly prokázány statisticky významné rozdíly.

V grafu č. 1 jsou uvedeny reprodukční ukazatele u skupin dojnic vytvořených podle produkce mléka. Z grafu je zřejmé, že lepších výsledků plodnosti dosáhly dojnice s nižší užitkovostí a horších výsledků dosáhly dojnice s vyšší užitkovostí.

Tělesná kondice byla sledována po celé období laktace. Graf č. 2 zobrazuje průběh kondičního skóre po jednotlivých měsících laktace. Průměrné hodnoty BCS při porodu dosahovaly 3,59 bodu.

V dalších měsících po porodu dochází k významnému poklesu kondice. K nejvýraznějšímu poklesu dochází do třetího měsíce po otelení. Další pokles je pozvolnější a minima je dosaženo v šestém měsíci po porodu hodnotou 2,43 bodu.

Ideální kondiční skóre se pohybuje mezi 3 – 4 body při zaprahnutí a mezi 2,5 – 3 body ve vrcholu laktace. Zjištěné průměrné hodnoty v době telení se pohybovaly na horní hranici optima. V průběhu laktace kondice poklesla o 1,16 bodu.

Ze zjištěných vztahů lze vyvodit, že ve sledovaném chovu na produkci a plodnost působí především chovatelské podmínky, výživa, zdravotní stav a management stáda. Vlivy jako sezóna roku nebo velikost tělesného rámce se příliš neuplatňují.

Dosahovanou užitkovost lze hodnotit jako uspokojivou. Výsledky reprodukce jsou méně příznivé. Zlepšení reprodukčních ukazatelů lze dosáhnout především větší pozorností věnované dojnicím zejména v období po otelení a při vyhledávání říjících se plemenic. Účelné by bylo zkrátit inseminační interval. K dosažení příznivějších výsledků by mělo rovněž přispět zlepšení výživy v první třetině laktace. To by mělo omezit ztráty tělesné kondice a zmírnit dopady negativní energetické bilance, která nepříznivě působí na reprodukční funkce.

INTRODUCTION

One of the most important conditions of successful and economical milk production is a good and regular fertility of cows. It means obtaining of one calf per one year from every cow. The main regularity in cattle keeping is the fact, that there's no production - neither beef nor dairy - without reproduction [4, 15].

Together, cows culling by reason of reproduction diseases shouldn´t exceed 10% from the total number of culled cows. Higher levels of this indicator often cause the economical loss. By the monitoring and evaluating of reproduction indexes it is possible neither to detect present problems in reproduction process, nor to check the signals about cows´ inability to adapt to their life conditions.

Altogether, there are significant correlations among particular reproduction indexes in cows. Also the relation between milk yield per a year and the length of calving to conception interval is significant (r=-0.175 and -0.147 in primiparous and multiparous cows, respectively). Several authors calculated that with decreased fertility under the optimal level the lactation prolongs [11]. At meantime prolongation above the level of 365 days the lactation is 0.7 day longer and the non-reproduction part of the lactation is 0.3 day longer per one prolonged day if meantime. Also SP prolongation causes milk yield increase per lactation, but simultaneously its decrease counted by calendar year and feeding day.

According to [17] the final reproduction results are formed by genetic part (20%) and environmental impact (80%).

Generally, focused at reproduction, the stanchionless housing is positive for the intensity and expressiveness

of heat manifestation. On the other side, at stanchion housing without the possibility of free movement or pasture the heat manifestation is much weaker, there is higher occurrence of silent heats and it leads to a longer calving to conception interval.

The reproduction process and its level very sensitively react to the quantity and mainly quality of nutrition. Reproduction functions declination reflects the nutrition insufficiency. According to [3] the most important for successful conception is the adequate nutrition in the period of dry period and during early lactation. In this critical period the loss of live weight of the cow shouldn't decrease more than 10%. Reproduction diseases have usually very close relationship to nutrition shortage [14]. Often up to 30% of cows in a herd have higher occurrence of ovarian cysts during the first 42 – 50 days of lactation; high doses of concentrates (grain feed) can influence the frequency of this disease [18].

These authors report [13] that almost every high-yielding cow is in the state of negative energy balance after calving; the target is to shorten this period to its minimum. Generally, the problems with reproduction getting worse with increasing milk performance, unsuitable body condition, and unbalanced feeding rate in organic and mineral nutrients content.

The reproduction management depends on the breeder; it concludes various periods during the reproduction cycle. Managed reproduction means practically all the steps and medical helps connected with reproduction functions, which aim at reproduction process influencing. Surely, the artificial insemination of assistance at calving can be included to reproduction management. The higher is the milk yield, the higher is the possibility of reproduction diseases occurrence, which is also connected with reproduction [13].

Authors [22] reported about significant correlation between reproduction efficiency and milk yield. High-yielding cows had longer both calving to first service and calving to conception intervals and more services per conception.

Negative energy balance in the beginning of lactation influences reproduction and body condition loss causes latest occurrence of ovarian cycles [21]. Body condition loses are caused by disproportion in feed intake and nutrition requirements. The practical possibility of the breeder how to keep required body condition score for optimal production capacity utilization and health maintaining is body condition score measurement and its subsequent regulation [19]. The end of lactation and dry period and postpartal period are considered as the most critical, because the cows getting fatter and subsequently after calving, they tend to the negative energy balance [6], which negatively influences fertility in the beginning of lactation. Marked condition loss delays ovarian cycles occurrence and reduces fertility [21].

The method for body condition evaluation is the palpation of body fat reserves appearance. The most important are these body areas: the backbone, backside, loins and tail root [6]. Only the visual assessment without palpation is not sufficient. Feeding rate changes are not immediately reflected in body condition changes, because the cow needs even several weeks to change its condition in one point. That´s why it is important to evaluate the body condition in timing advance to catch small changes and to shorten the time required for the correction. The condition evaluation should be made by the same person [5] in four weeks intervals. In Holstein cows, the body condition score at dry off should be 3.0 – 3.5 points and it shouldn´t decrease more than 1 point after calving. Optimal condition score ranged from 3 to 4 points at dry off and from 2.5 – 3 points at the peak of lactation [6].

The aim of this study was to evaluate the reproduction indexes depending on milk yield and body condition level at the conditions of family farm.

MATERIAL AND METHODS

The questions of reproduction indicators and milk yield were observed at a family farm, which was established on the base of restitutions in 1992.

At the present time the farm manages on 73 hectares of agriculture land; 55 ha is arable land, 18 ha are grass fields and pastures. The farm is located in the potato-production area, 360-380 meters above sea level in the LFA. The crop production is focused on production of feeding crops. The animal production is entirely focused on Holstein cows breeding with close herd turnover. The herd is registered in the Herd-book and 80% of cows are purebred Holsteins.

The cows are fed once a day by the total mixed ration dosed by the mixing wagon. The feeding rate is based on corn silage with clover silage, grass silage or legume-grain silage, eventually with the addition of straw. Green fodder is preserved in the round bales. One part of grain feed is fed within the TMR and the second one is fed individually during milking.

The basic dataset was collected during the years 2004 – 2007. The data about milk performance and fertility were obtained from herd evidence, monthly performance control results, lactation records and insemination records. The extreme values were removed from the basic dataset. According to the aims of this study, the data were divided into these groups:

1. Evaluation of the groups according to the milk yield:
I. 1st group – milk yield up to 7 000 kg of milk
II. 2nd group – milk yield from 7 000 to 8 000 kg of milk
III. 3rd group – milk yield more than 8 000 kg of milk
These indexes were compared: calving to conception interval, calving to first service interval, number of services per conception.

2. Body condition evaluation during the lactation
The body condition score development was observed in the group of cows every month. Also, body condition was measured at conception. For the measurement, the 5 point scale was used (1= thin cow; 5=over conditioned cow)

The basic statistical characteristics were found. The impact of particular factors was proved by the one factorial analysis of variance ANOVA. Statistical significance was proved at these significance levels:
+++ high statistical significance $P \leq 0.001$
++ medium statistical significance $P \leq 0.01$
+ significant $P \leq 0.05$

RESULTS AND DISCUSSION

Table 1 displays milk performance control results in particular years of observation. It is obvious, that the length of meantime increases and, on the other hand, the average production age of the cows decreases.

The reproduction indexes were evaluated in the groups of cows created according to their milk yield. The basic observed reproduction indicators were: calving to first service interval, calving to conception interval and number of services per conception.

Table 2 shows the length of insemination interval in particular groups of cows, including basic statistics. The trend among the groups is the same as in the case of the length of calving to conception interval. In each group, the length of calving to conception interval is about 55 days longer than the length of insemination interval. The shorter calving to first service interval had the group of cows with lowest milk yield (up to 7000 kg) – 96 days, the longest value was in the group with highest milk yield – 122 days. This shows that the first insemination in high yielding cows is deferred by the high energy demands for high milk production. According to [16] the length of calving to first service interval more than 60 days is unsatisfactory for the average – yielded herds. All the groups showed large variability in particular data value: the minimal length was 32 days, the maximal 233 days. According to [7], the most optimal is to achieve the length of calving to first service interval 50-60 days in particular herd.

[1] mentioned, that it is possible to achieve the length of calving to first service interval 50 – 60 days on the condition that the animals are not stressed by high milk yield, feeding and others factors. According to most of authors the optimal length of calving to first service interval is approx. 60 days. In the observed herd only a small part of cows had been inseminated up to 60th day after calving, which is embarrassing. In this regard the calving to first service interval should be considered as very poor and it would be efficient to shorten its length.

Table 3 shows the length of calving to conception interval and the basics statistics. There were no statistically significant differences among particular groups. At average values comparison, the calving to conception interval elongates with increased milk yield. The average length of this indicator was 154 days and 171 days in the first (milk yield up to 7000 kg) and third (milk yield more than 8000 kg) group, respectively. With adding the average gestation length (285 days) the average length of meantime is 439 days and 456 days in first and third group, respectively. These authors [10] report, that the optimal length of meantime is up to 380 days, in high yielding cows (more than 7000 kg) it is possible to accept the length up to 400 days with the adequate prolongation

Table 1 – Milk performance control results - Výsledky kontroly užitkovosti

Year Rok	Number of cows Počet krav	Milk yield kg Dojivost	% of protein % bílkovin	Meantime Mezidobí	Average lactation number Průměrné pořadí laktace
2004	37	8332	3.29	397	2.6
2005	38	6795	3.24	462	2.7
2006	44	7457	3.22	426	2.5
2007	41	8096	3.17	487	2.3

Table 2 – Calving to first service interval length according to milk yield (days) - Délka inseminačního intervalu ve dnech podle produkce mléka

Indicator Ukazatel	n	$\bar{x}$	s_x	V %	Min	Max	F
< 7000 kg	46	96.41	39.78	40.13	32	232	5.34 $^{++}$
7000-8000 kg	29	110.79	39.28	35.45	50	233	1:3
> 8000 kg	48	122.00	34.43	28.22	43	201	
total	123	109.33	38.95	35.66	32	233	

Table 3 – Calving to conception interval length according to milk yield (days) - Délka servis periody ve dnech podle produkce mléka

Indicator Ukazatel	n	$\bar{x}$	s_x	V %	Min	Max	F
< 7000 kg	46	154.26	73.68	47.76	32	344	1.01
7000-8000 kg	29	164.72	80.52	48.88	62	353	
> 8000 kg	48	171.48	63.13	37.16	62	345	
total	123	163.02	71.84	44.07	32	353	

Table 4 – Number of services per conception according to milk yield - Inseminační index podle produkce mléka

Indicator Ukazatel	n	$\bar{x}$	s_x	V %	Min	Max	F
< 7000 kg	46	1.89	1.05	55.38	1	5	0.52
7000-8000 kg	29	1.76	1.04	59.08	1	4	
> 8000 kg	48	2.02	1.16	57.58	1	6	
total	123	1.91	1.10	57.42	1	6	

of calving to first service and conception intervals. All the groups had a high variability in the length of calving to conception interval; the minimal value (32 days) had the group with the lowest milk yield, the maximal value (353 days) had the second group (milk yield 7000 – 8000 kg). These lengths of calving to conception interval are considered as: excellent: up to 80 days; good: 81 – 90 days; weaker: 91 – 110 days and poor: more than 110 days. According to most of authors, the length of calving to conception interval should be evaluated as poor.

In the table 4 there is displayed number of services per conception according to particular groups of cows. There were found no significant differences. The lowest average value (1.76) had the second group (milk yield 7000 – 8000 kg of milk). The highest average value (2.02) had the third group with the highest milk yield. The number of services per conception is very good at the level up to 1.5 and good at the level from 1.6-1.8 [2]. When it is higher than 2.0, it should be considered as unsuitable. [1] evaluates the number of services per conception as suitable at the level up to 2. On that ground this indicator has been evaluated as suitable in observed herd.

All the observed reproduction indexes displayed according to the level of milk yield are shown in the figure 1. It is obvious, that better results had the low-yielded cows and worse results had the high-yielded cows. According to [8] the milk yield is the stress factor for fertility at exceeding the physiological level. They resulted from the fact that the lactation is superior to reproduction process and milk production is impaired later than fertility. The higher is the milk yield, the higher is the possibility of having production diseases, which are also related to reproduction [13]. The fertility of the herd is influenced by management (50%), quality of insemination services (30%) and climatic and hygienic conditions (20%). Generally, the results of reproduction in observed herd should be evaluated as poor according to most of the authors. For their improving it could be efficient to take

more care of the cows after calving and to shorten the length of calving to first service interval.

BCS was measured during the whole lactation every month. The development of BCS is displayed in the figure 2. At calving average BCS was 3.59 points. It was mentioned by [9], that the optimal BCS level at calving should ranged from 3.25 to 3.75 points in Holsteins. These authors [20] determined that 3.0 – 3.5 points of BCS is the optimal level at calving.

After calving a significant BCS loss was caused. The highest loss was till the third month of lactation. The subsequent decrease is gradual and the BCS nadir occurs in the 6th month of lactation (2.43 points). According to [12] the body condition post partum decreases (up to 1 – 1,5 points), whereas the body weight loss up to 30 – 45 kg till the 70th – 80th day of lactation could be considered as physiological. From the 6th month of lactation (150-180 days) BCS gradually increased. In the 10th month of lactation (300 days), at the end of standardized lactation, the BCS level was 3 points. According to the length of meantime, BCS increased also in the next months of lactation. After the 70th day of lactation the body condition should gradually increase and this is influenced by the level of nutrition and milk yield.

At drying off the BCS level should achieve 3 – 3.5 points in Holstein cattle and shouldn´t decrease more than 1 point [6]. Optimal BCS level range from 3 to 4 points at drying off and from 2.5 to 3 points at the peak of lactation. The average BCS levels at calving were at the upper optimum margin. BCS loss during the lactation was 1.16 points.

The cows with BCS more than 4 points have greater risk of getting fat, which causes calving difficulties, placenta retention, endometritis, mastitis and ketosis. The cows with the body condition less then 3 points have less health diseases, but they also have lower potency to achieve sufficient milk yield and to have enough body reserves for conceiving [19]. According to [9] most of these problems could be prevented if the cows achieve optimal BCS level before the end of lactation. [6] mentioned, that body condition score decreases due to the negative energy balance. The cow uses her body reserves to reach maximal milk production. The negative energy balance influences reproduction at the beginning of lactation. Marked BCS loss causes delay in ovarian cycles occurrence and decreases fertility [21]. Also these authors [20] reported, that the cows with positive energy balance have higher chance to be pregnant, which is

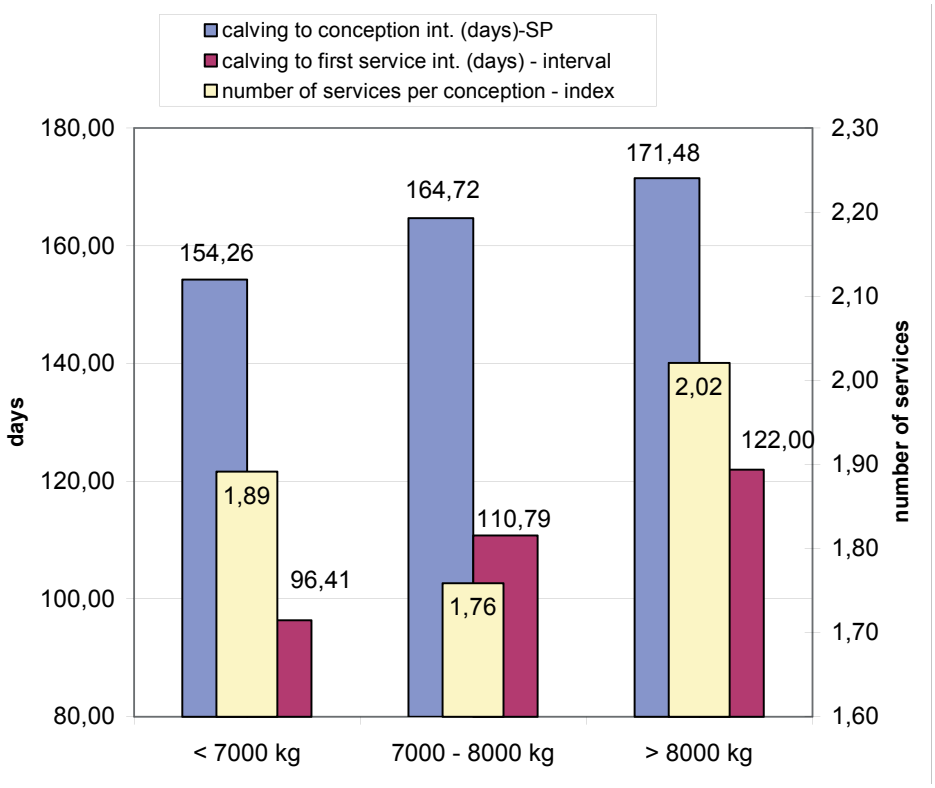

Figure 1 – Summary of reproduction indexes according to milk yield - Shrnutí ukazatelů plodnosti u skupin podle produkce mléka

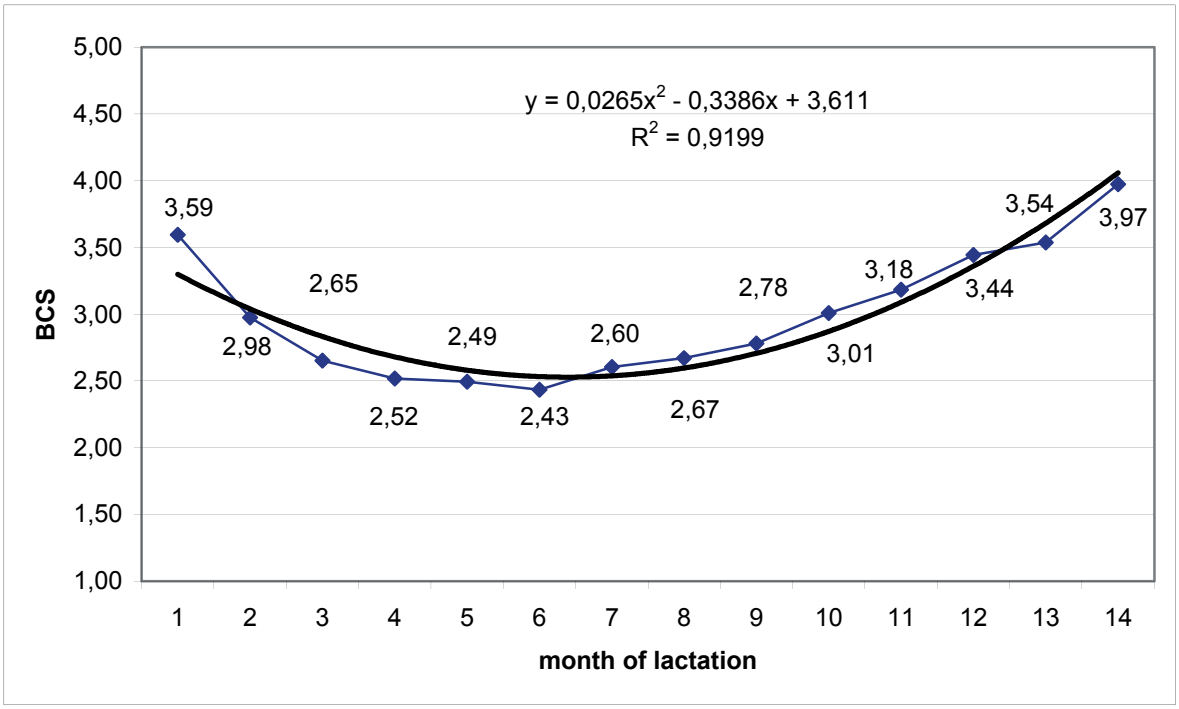

Figure 2 – BCS development in particular months of lactation - Vývoj BCS v laktaci po měsících

expressed by increasing BCS.

CONCLUSIONS

The aim of this study was to consider the level of milk yield and feritility in Holstein cows at the specific condition of a family farm. Subsequent conclusions could be deduced:

• Increasing milk yield in particular groups (milk yield up to 7000 kg; 7000 – 8000 kg and more than 8000 kg) has a negative impact on reproduction indicators. Significant differences were found in the case of the length of calving to first service interval. The average length of this interval was 96, 111 and 122 days in particular groups. The length of calving to first service interval reflected the length of calving to conception interval, which was 154, 165 and 171 days in particular groups. There were found no significant differences in the case of numbers of services per conception.

• Average BCS level at the beginning of lactation was 3.59 points. After calving BCS decreased till the 6th month of lactation (by up to 2.43 points) and then it gradually increased. BCS level at conception was under 2.5 points. BCS levels within particular lactation periods ranged in the space of 2 points.

Amounted milk yield could be evaluated as sufficient. Reproduction results are less favourable. For their improving it could be efficient to take more care of the cows after calving and by heat detection. It could be also efficient to shorten the calving to first service interval. Also nutrition improvement in the one third of lactation could help to achieve better results. This should reduce BCS loss and moderate impact of negative energy balance which affects reproduction process.

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